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SUSPENSION

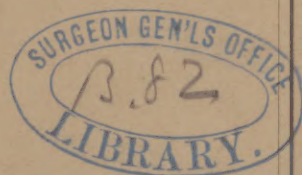
AS A

MEANS OF TREATING SPINAL DISTORTIONS.

BY

BENJAMIN LEE, A.M., M.D.,
OF PHILADELPHIA

EXTRACTED FROM THE
TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION.



PHILADELPHIA:
COLLINS, PRINTER, 705 JAYNE STREET.
1877.

Compliments of
Benjamin Lee, M. D.,
1608 Spruce St.; Phila.

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SUSPENSION AS A MEANS OF TREATING SPINAL DISTORTIONS.

AT the meeting of this Association in 1866, I had the honor to present my views in regard to the correct principles of treatment for angular curvature of the spine, in a paper which was recommended for publication by the Committee on Prize Essays, the accidental disclosure of my name having excluded it from competition. In that paper it was maintained that efficient extension of the spinal column by means of any of the apparatus worn upon the person devised for that purpose, was impossible; and that the only available principle for instrumental support was the separation of the vertebral bodies by means of antero-posterior force, the oblique articulating processes being made use of as a fulcrum. But, as extension gave us such valuable results when applied to inflamed or ulcerated diarthrodial joints, it appeared unfortunate to be compelled to lose the benefit of it altogether as regarded the symphysial articulations of the spine, which in a state of disease are more closely assimilated to the former than in health. I, therefore, suggested that, although unable to avail ourselves of it by means of portable appliances, as in the case of disease of the hip-joint, we might still do so through the medium of apparatus having a fixed point of support entirely disconnected from the body of the patient, as indeed had been done by the late Prof. J. K. Mitchell, of Philadelphia, forty years before, and by Bampfield, Sheldrake, and others in England, still earlier, by suspending the patient by the head. I considered that there were three classes of cases in which this method formed a very useful adjunct to the other mode of treatment—

“1st. Those in which the cervical vertebræ are the seat of disease; for, while we are generally able to arrest the progress of

the disease in this region by antero-posterior force, we cannot accomplish much in the way of correcting deformity.

"2d. Where, for any reason, whether caries of transverse processes, abscess, ulcers resulting from the use (or abuse) of issues, moxas *et id omne genus*, hyperæsthesia of the surface or extreme delicacy, tenderness, and irritability of the integuments, the requisite amount of antero-posterior pressure cannot be borne, save for a limited time, each day; and

"3d. Those cases which, while their destructive progress may have been arrested, and the posterior projection somewhat diminished, exhibit a tendency to the phase of deformity denominated *lordosis*. This distortion is owing apparently to a compression of the intervertebral substances posteriorly, or possibly to a partial absorption of the oblique processes, in the lumbar region, it being rarely seen higher up." "It is difficult to bring antero-posterior force to bear in such a way as to arrest it, because the anterior surface of the spine is so deeply protected by the abdominal viscera that pressure cannot reach it."

A more extended experience soon convinced me, however, that while suspension had indeed a peculiar applicability to these classes of cases, there was no phase and no stage of the disease in which it could not be employed to very great advantage. Thus far my extension had been entirely passive, the patient taking no part in producing it, and adjustment by an assistant through the medium of a ratchet being necessary. (Fig. 1.) Having a little patient who under its use had entirely recovered from complete paralysis of the muscles of the trunk and lower extremities, and arrived at a better condition of general health than he had ever before enjoyed, I was anxious to devise some plan for improving the shape and increasing the capacity of his thorax anteriorly and superiorly, and diminishing the prominence of the lower end of the sternum. Observing one day, while revolving this problem, that he occasionally took hold of the rod which carried the head-sling and drew himself up toward it by his hands in order to relieve his chin from pressure, it occurred to me that if, instead of this adjustable rod, I should substitute a cord passing over a pulley, attached at some distance above the head, and put the other end of the cord in his hands, I should place the counter-extension under his own control, thus giving him an opportunity to relieve the pressure on the chin at will, and at the same time dividing the traction equally between the arms and the neck, instead of

Fig. 1.



Direct Suspension.

having the entire weight supported by the latter. I immediately had an apparatus made on this principle, which I denominated the *spinal swing* (Fig. 2), and the ease, and even eagerness, with which the little fellow at once made use of it, assured me that, as far as his comfort and enjoyment were concerned, the modification was one of great importance. Nor was I disappointed in regard to the more permanent advantages which I hoped to reap. The distortion of thorax soon began to show signs of improvement. Its development superiorly increased, his respiration became more easy and free, his blood was better aerated, the tumid abdomen subsided, and the muscles of the arms and upper part of the trunk increased in volume. As there was a tendency in his case to lateral deviation, I attempted to remedy this by placing two wooden ovals on the cord at uneven distances above his head, and causing him, for a certain length of time each day, to suspend himself by taking hold of the higher oval with the hand corresponding to the depressed shoulder, and of the lower with the other hand, hoping in this way to reverse the lateral curve. This proved so effective that I was led to adopt the apparatus in the management of true lateral curvature, and was greatly pleased to find that I had added a new and valuable mechanism to our means of correcting this obstinate form of deformity. The little patient referred to above I had the pleasure of presenting before the Medical Society of the State of Pennsylvania, at its session in the city of Philadelphia in the year 1870, together with two others, who had been treated by this method for spinal caries. I briefly quote from the history of one of these cases, as illustrating the rapidity with which improvement is thus produced. Her condition, when I was called to see her by her family physician, was as follows:—

She was seventeen years of age, a Jewess, and therefore probably not of a strumous diathesis, and had enjoyed perfect health until about a year before. Beginning with slight pain in the back and head, she had gradually gone on from bad to worse until she was now confined to the couch, entirely unable to walk without assistance, standing with her hands on her knees, liable to fall suddenly without a moment's warning, suffering from almost constant severe headache and excruciating pain in the left hip. Had frequent attacks of obstinate vomiting, was without appetite, and much emaciated. Often screamed out in her sleep at night, as those do who are suffering from hip-joint disease. As there

was no evidence of impaired mobility in this joint, however, further than could be accounted for on the supposition of a contraction of the psoas muscle, I concluded, although there was not the slightest deformity or projection of the spine, that there was ulcerative action going on in some of the intervertebral articulations. From the absence of gastralgia I considered it to be below the dorsal region, and from the intense pain in the hip, quite low in the lumbar region, very probably the vertebro-sacral junction. With the consent of her physician, I caused a spinal swing to be hung directly over the couch on which she lay, and directed her to use it, sitting, for ten minutes three times a day, and gradually to increase the time as she became accustomed to the traction. The relief which the first attempt gave her was so great that she very quickly exceeded the time prescribed. By the end of one week her excruciating pains had entirely left her, there was no nausea or vomiting, and her appetite had returned in a very encouraging manner. The morning rigidity had also greatly diminished. By the end of the third week, however, I thought that I could detect a slight prominence of the last lumbar vertebra, and, as she was anxious to return to her trade, and I did not think it safe for her to walk long distances without mechanical support, I ordered a splint to be made for her. Four weeks from the time of commencing the use of the swing she walked to my office, a distance of half a mile, to have the splint applied. Her recovery under the combined use of the swing and the splint was rapid, uninterrupted, and complete.

The following case is not less striking and conclusive:—

On the first of December, 1875, I was called upon by Mrs. W., the widow of a physician of this city (Philadelphia), who, with tears in her eyes, besought me to come and see her little daughter, if, after hearing her history, I thought there was the slightest reason to hope that I could do anything to alleviate her distressing condition. She gave me, in substance, the following

History, in which, however, I take the liberty, for the sake of unity in the narrative, of incorporating certain details which I afterwards learned from time to time. The father had died of phthisis, and other cases of the same disease had occurred in his immediate connection. The mother's own health and antecedents were good. She possessed great endurance and a fine physique. The patient "was always a very nervous child; had had none of the contagious diseases of childhood, but was subject to an

eruption, which always made its appearance when she was feeling badly. Formerly, as soon as she felt better, it would disappear entirely, leaving the surface perfectly clear." (This eruption was an eczema, choosing by preference the eyebrows and lids, the scalp, and the flexures of the elbows and fingers, never appearing on the body or lower extremities.) "As soon as she was able to walk she began to complain of pain in her back, especially on stooping, the pain being rather confined to the lower part of the back. At the age of four years she suddenly lost the use of her lower limbs, while at play, and continued helpless for twenty-four hours, the attack being entirely painless. From that time the eruption *became permanent* in the bend of her arms and hands, lasting for five years and disappearing under the influence of sea-air in the summer of 1874, her general health at the same time improving in every respect." In October of the same year, while on her way home from school, she fell over a bucket, striking with the epigastrium heavily upon its edge. "The pain, which was severe, seemed to go through to her back. She felt sick at her stomach, and weak in her legs the rest of the day, and awoke the next morning with a slight chill down her back and unable to stand on her feet." Each day the loss of power became more pronounced, and the chilly sensations were repeated at intervals. Her physician, an eminent practitioner of this city, was inclined to attribute her condition to malarial poisoning, and put her on quinine, gradually increased to very full doses, but without producing improvement or inducing its physiological effects on the nervous system.

She was now confined to the bed, without suffering but helpless, in tolerable health and spirits, for five months, when on the 23d of March she was attacked with violent chorea. The spasms of both upper and lower extremities were so violent as to throw her out of bed; but when held on the lap the arms became tranquil or nearly so, the agitation being then confined to her legs. She soon became almost sleepless, being extremely sensitive to noises. She was at this time seen by an eminent consultant, but no remedies which he could suggest availed to control the spasms. Placing the feet in very hot water had a tranquillizing effect for the time, but her feet became so tender that it was impossible to continue the use of this means. From the onset of this attack until the 12th of June, a period of twelve weeks, the only sleep that she got was in her mother's arms. On the day named she was taken

to Atlantic City, and that night slept on a bed. The choreic manifestations now gradually diminished, and by the end of August, when she was brought back to Philadelphia, had entirely ceased. During this time she was seen by several physicians, one of whom suggested and employed free counter irritation by croton oil to the back. As the limbs became tranquil they also again became powerless, and a new symptom made its appearance, namely, excessive sensitiveness along the spine, so that "she could not bear the slightest touch." She now came under the care of a highly intelligent practitioner, who appears to have looked upon the case as purely hysterical, and who lost the good-will and confidence of the patient (a fatal obstacle to success in many neuroses) by allowing her to see that he doubted the reality of her sufferings. She continued helpless until the month of October, about a year from the time of her accident, when suddenly, while eating, her jaws became rigidly closed and "for twenty-four hours she could neither speak nor swallow." When they finally relaxed it was to give utterance to a fearful "scream." This scream had been repeated every few minutes during her waking hours up to the present time. The attending physician had frankly told her mother that he could do nothing for her, as long as she remained at home, as she had entirely lost self-control and will power. He therefore advised her to place the child for a time in the "Infirmary for Nervous Diseases." This step she naturally shrank from, and had come to me as a last resort, in hopes of being able to avoid it. Obtaining her consent to my employing whatever mechanical appliances I thought advisable, and the promise of her co-operation in whatever course I might suggest, in case I considered the case sufficiently promising to undertake it, I saw the child the next day.

Her *Condition* at the time of my examination was as follows: She was excessively pallid, lips bloodless, face somewhat puffy, having a dropsical appearance. Her body and limbs were well covered with flesh, but it was extremely soft and flabby, presenting none of the resilience of healthy muscular tissue under pressure. Her entire muscular system was in a state of extreme debility. The only region in which this appeared to amount to positive paralysis was the neck. When lifted into the sitting posture, her head would drop completely like that of a person in a dead faint. All the other muscles responded, though feebly and sluggishly, to the stimulus of the will. She was able to flex

the extremities, but required assistance in flexing the thigh on account of the weight of the limb. She was entirely unable to turn herself in bed, lying most of the time on the left side. All muscular effort, as well as passive movements of the limbs, and especially lifting of the trunk, caused excruciating pain in the back, which continued for a space of time varying from ten minutes to a half hour or even longer. Mental effort was likewise distasteful. She could not read or fix her eyes or even her attention on any object or subject for any length of time, without great weariness, irritability, and increased pain. Headache was frequent, but usually not very severe.

She took little interest in what was going on around her, even the playing of children affording her no amusement, but rather distressing her. She was thoroughly apathetic, not having the slightest desire for recovery, and rather resenting all proposals to produce such a result. Her natural temperament is decidedly phlegmatic, not inclining in the least to extreme nervous excitability or hysteroidal emotion. Her circulation was languid, feet cool to the touch, but her constant complaint, even in cold weather, was that she was "too hot." She perspired freely even when lightly covered. Her appetite was good, and her bowels tolerably regular; but she was subject every few weeks to attacks of purging, accompanied by nausea and, occasionally, vomiting, for which her mother was in the habit of giving her a mild mercurial. She slept quietly at night, although for a comparatively short time for a child.

Her urine was irregular in quantity, of high specific gravity (1030), very turbid, of alkaline reaction and strongly putrescent odor, and deposited immense quantities of amorphous phosphate of lime. There was a slight muco-purulent discharge from the vagina, and the *ostium vaginæ* was decidedly redder than natural. The pulse was feeble and rather frequent. There were no reflex contractions of the lower extremities. The *natis* of the right side was somewhat flattened and less firm than that of the left, and the *gastrocnemius* of the same side was more relaxed, allowing the heel to come down further than its fellow. All the muscles and ligaments were greatly relaxed. The feet were so deficient in sensibility that she could not tell where they were lying, but there were no abnormal subjective sensations.

But the most remarkable, and, to her mother and friends, most distressing symptom in her case was the singular vocal utterance,

referred to in her mother's account. This occurred only during hours of wakefulness, never in sleep, at intervals of rarely more than ten minutes, often not more than ten seconds, the interval being shortened by mental excitement and physical suffering. It began with an apparent closure of the posterior nares, producing the sound represented by the letters *ung*: this was followed by a powerful and rapid expiratory effort, throwing the vocal cords into strong vibration, and causing an inarticulate, rasping sound which I can compare to nothing but that of a watchman's rattle. Then followed one or two rapid sobbing inhalations, when, if the outcry were not immediately repeated, respiration became tranquil for a short time. The noise was excessively loud, could be heard all over the house, and, when the windows were open, for a considerable distance in the street. It seemed as though her larynx must be necessarily denuded of epithelium by the constant repetition of this strong vocal effort, and yet her voice in speaking was soft and natural, and she rarely complained of sore throat or hoarseness. Judging from its effects upon myself during my comparatively short visits, its influence upon those who were compelled to be with her constantly must have been almost distracting. My examination, of course, excited her greatly, and her cries were therefore almost incessant, so that it was with difficulty that I could make myself heard by the mother.

Diagnosis.—Without endeavoring to give a single definite name to this congeries of symptoms, I thought the following points sufficiently well defined. *First*, the existence of a neurotic diathesis, if I may be allowed the term, as shown by the attack of transient paralysis in early childhood, and by the symmetrical, persistent eruption, constantly recurring, and always associated with ill health and often with nervous manifestations. *Secondly*, the receipt of an injury, followed by symptoms pointing to a lesion of the spinal cord, of slight gravity, not involving the meninges seriously, but indicating a concurrent injury either to the vertebrae of the same region, or to the inter-articular cartilages, more probably the latter. *Thirdly*, the existence, at one time, of well-marked chorea, of the ordinary type, but of unusual violence, undoubtedly dependent on the abnormal condition of the spinal cord. *Fourthly*, the character of the urine I held to negative the possibility of the existence of hysteria, and to point to congestion of the spinal cord. A fact subsequently appeared

which strengthened my belief in the existence of congestion of the cord, viz., that on being placed in bed after having been for some time in the upright posture she suffered intense pain in the back for a period varying from one-half to three-quarters of an hour. The age of the patient, only ten years, also militated against the idea of hysteria. The vocal utterance, which the patient herself said, simply enough, she made "because she couldn't help it, and because her back hurt her so," I took to be a true chorea of the muscles of respiration including the diaphragm; and the pain in the back, which she thought caused her to cry out, I supposed to result from the spasmodic contraction of these muscles. Finally, I was impressed with the fact that the volitional connection between the central nerve masses and the muscular fibrils, interrupted by the injury, had been gradually restored to a much greater extent than the patient imagined, and that, if the sentient extremities of the nerves could be roused to functional activity, the capillaries of the muscles stimulated to a healthier tone, and the nutrition of the muscles themselves improved, she would soon become conscious of renewed will power, and be in a condition to *learn to walk* once more; for she had not stood on her feet, it will be remembered, for fourteen months. Not intensely scientific perhaps, but still it appeared to me a good working theory, and one on which I could venture to base a favorable *prognosis*. I accordingly promised her that I would "make her well," if she would give me her hearty co-operation. I knew perfectly well that I should not have it at the outset, as she desired nothing so much as "to be let alone," but I preferred to have her fully impressed with the idea that I thought that I possessed it, and this impression I never for a moment allowed her to disabuse herself of, always acting as though I were fully convinced that every instruction which I gave her, as, for instance, those in regard to movements of the limbs during manipulation, was promptly obeyed. My prognosis to her mother was, of course, rather more guarded, but still I felt warranted in making it encouraging. I predicted that the increase in muscular availability would be very gradual, but that the cessation of the choreic vocal spasm would be abrupt, although some amelioration might precede it, and that the pain and sensitiveness along the spine would be the last symptom to yield. I commenced the

Treatment at the same visit, the first step being acto-passive movements of the hands and feet. Taking the wrist in my left

hand, and the fingers in my right. I directed her to flex the fingers. I was obliged to repeat the command several times before there was the slightest effort to obey, but the moment that I felt a faint muscular tremor I assisted in the performance of the movement and made it very complete, in order to put the extensors well on the stretch. This was repeated three times for each upper and lower extremity. The next day I sent a female manipulator to her, with the following prescription:—

1. Arm kneading, 5 minutes; rest, 2 minutes.
2. Flexion and extension of hands, 9 times; rest, 3 minutes.
3. Leg kneading, 5 minutes; rest, 2 minutes.
4. Flexion and extension of feet, 9 times; rest, 3 minutes.
5. Flexion and extension of arms, 9 times; rest, 3 minutes.
6. Kneading of thighs, 5 minutes; rest, 2 minutes.
7. Flexion and extension of legs, 9 times; rest, 3 minutes.
8. Rotation of feet, 3 minutes; rest, 2 minutes.
9. Kneading of abdomen, 3 minutes; rest, 2 minutes.
10. Kneading of back, 3 minutes; rest, 2 minutes.

The first four movements only were to be given on the first day, and those only in part and with increased intervals of rest. The others were to be gradually added. This course of exercise was very distasteful to her, and temporarily increased the pain in her back. She often shed tears during the *séance*, and her peculiar cries were then almost incessant, but entirely distinct from the sounds of weeping, which they abruptly interrupted. It was continued with more or less regularity for three months, having been interrupted by two attacks of bilious diarrhœa. At the end of this time, the circulation had greatly improved in the extremities; muscular power was decidedly increased except in the neck and trunk, where paralysis still seemed complete; sensation was natural in the feet; her spirits were greatly improved; she began to be fond of reading, and even expressed a desire to get well. I now determined to make use of self-suspension, with three distinct objects in view. First, to relieve the pressure on the intervertebral cartilages, which I conceived might be causing a congestion of the cord and thus keeping up the chorea. Secondly to afford the muscles of the trunk and upper extremities an opportunity for active exercise; and, thirdly, to accustom the circulatory system to the upright posture, as a preparation for standing and walking. Accordingly, on the 29th of February, I had a stout frame eight feet high put up over her bed, and a spinal swing attached to it. With very great difficulty, owing

to the complete relaxation of the muscles and ligaments of the cervical spine, we succeeded in getting her head into the sling, and she remained sitting, almost entirely supported by the head, occasionally assisting a little with the hands for about five minutes. The day following her mother again suspended her, with much less difficulty, and at her own request, so great was the relief which the employment of suspension, even for so short a time, had given her. To the utter astonishment of herself, her mother and the entire household, the terrible outcries, which she had been uttering like one possessed for five months, and which had been very distressing when I was there only the day before, ceased while she was suspending herself, and did not return when she lay down. Nor has there ever been the slightest renewal of them to the present time.

I now applied a pair of steel knee splints to the legs, partly to overcome a slight contraction of the hamstring muscles, but principally in order to husband her nerve-force in standing. After she had worn them for a few days I had the slats taken out of her bedstead, and allowed her to stand inside of it, supported and partially suspended by the swing. She was now ready to attempt locomotion with artificial assistance. This I provided in the shape of a wheel crutch, to which I requested Mr. Darrach, of Newark, N. J., its inventor, to attach a stout steel bow, passing over the head and carrying a sling by means of which suspension might be maintained while she was walking. She made her first essay at locomotion in the crutch on the 11th of March, and by the 1st of June was able, with the aid of knee splints and a spinal splint, to walk across the room alone. Her improvement has continued, with some interruptions, so that now for many months she has walked without any other support than a spinal corset. The hyperæsthesia of the spinal region still continues, though greatly diminished; and the eczema has recently made its appearance again in the flexure of the elbows. The other remedies used during the management of the case, were—ether spray to the spine, inunctions of the back and limbs with phosphorated oil, the internal exhibition of salicylic acid and salicylate of soda to correct the putrescence of the urine (which it did most happily), and the use of a vaginal injection (of which I append the formula) to relieve the irritable condition of that region and to carry off ascarides in case of their having found a lodgment

there.¹ None of these parasites, however, were ever discovered, although the closest scrutiny was exercised.

I could multiply instances showing the excellent and often surprising results attainable by the use of self-suspension in appropriate cases, but the above will suffice as characteristic examples.

An added interest and importance has accrued to this mode of treatment within the past three years, from its adoption by our distinguished fellow-member, Prof. Lewis A. Sayre, who (I risk nothing in saying before this audience) has done more than any one man to give interest to the meetings of this Section, and value to its transactions. With his characteristic readiness to accept new ideas, and to adopt and, it must be confessed, usually to improve upon new methods, he has devised a plan, as simple as it is effective, for maintaining permanently the extension which suspension enables us to accomplish. This consists in the use of the plaster-of-Paris dressing or jacket, described in his interesting paper before this Section, at Philadelphia, last year; the value of which he so successfully demonstrated in our presence. With regard to this daring innovation, I have only to say that it carries out more fully and completely than any other the principle which I ventured to enunciate years ago—that in the treatment of Pott's disease, that is, caries of the spine, or its antecedent, spinal arthrodchondritis, our aim should be, disregarding the time-honored dogmas of its essentially strumous and constitutional origin and tuberculous nature, to bring ourselves to look upon it as nearly as possible as we do upon a fracture of a long bone. First, *extension*; secondly, *fixation*; these are the grand desiderata in the one, so must they be in the other. One more thought I must add in this connection. It is often said to me, "Doctor, there is a little child in our family connection, or town, or neighborhood, suffering from spinal disease, and they think of bringing it to you to have an apparatus applied; but they fear that it is too feeble at present to wear one, and have concluded to wait until its strength is built up." The same story of prudential and expectant delay is often told when patients are brought to my

¹ R. Acid. salicyl.,
Sodæ borat., aa ʒj.

Misce intime.

After deliquescence has taken place, dry and repulverize.

S. One or two teaspoonfuls to a pint of water as a vaginal injection.

office in all stages of deformity. Gentlemen, I beg you to believe that a patient with this affection is *never too feeble* for the careful and judicious application of these principles. Let us recur to our type, the broken bone. Is there one of us who, if called to a patient suffering from a hitherto unrecognized fracture of the thigh, with all the symptoms of local irritation, hectic, night-sweats, exhaustion, pain, and inflammation, would say, "This patient is too weak at present for any local treatment; he could not bear the application of splints; let us build up his general health with tonics and stimulants, and perhaps after a few months he may be able to have the fracture set? We all know what the result would be. If he did regain his strength, it would be because nature's wise but rude surgery had finally put on the splint which we refused to apply, and had consolidated the fracture indeed, but with frightful and irremediable deformity. Or, if, as is very possible, he failed to regain his strength, it would be because the inflammation had gone on to suppuration, and phlegmonous erysipelas or necrosis with wasting discharge, and perhaps consequent albuminuria, had closed the scene. And yet, as I said twelve years ago, before the Medical Society of the State of Pennsylvania, "What condition have we in spinal caries," at least in a large majority of cases, "that does not exist in a case of neglected fracture of a long bone?" In both there is solution of continuity, with inflammation of osseous tissue, aggravated by motion and pressure. Delay in these cases is most disastrous. Every day increases the destruction of vertebral substance; every day stimulates irritated muscles to increased contraction; every day adds to deformity, and heightens the risk of suppuration. Confinement to the bed will not prevent these sad results. For it is not simply the superincumbent weight of the head and trunk which causes the softening spine to bulge at its weakest point. It is the active contraction of the muscles of the face of the trunk, of the diaphragm, and of the psoas. Hence, deformity may occur to an excessive degree, even though the patient be kept as far as possible supine and thus denied the incalculable advantages of fresh air and exercise. And it is just here that suspension and self-suspension come in as a most admirable immediate and mediate resource. No matter how weak the patient may be, a spinal swing may be hung directly over his bed; he can be raised into the sitting posture; the head sling can be applied and gentle traction made, sufficient at least to counterbalance the weight of

the head. The feeling of relief and ease will almost instantly begin, and he will in all probability use what little strength he has in grasping the rope to endeavor to increase the extension. Day by day he will use more and more force, making extension more complete, and gaining strength with every renewed effort. All the muscles of the trunk and abdomen will respond to the grateful stimulus of the will, and the performance of function. The blood will rush through the dwindled capillaries in unaccustomed torrents. The expanding thorax will invite an augmented volume of air into the shrunken lungs, and the brain will receive an amount of enlivening oxygen to which it has long been a stranger. The whole being, in short, will be sensible of a marked exaltation of spirit and comfort of sensation as surprising as they are delightful; and the patient, with hopes rekindled, will be ready to make any effort that may be required of him for the permanent possession of the benefits thus temporarily obtained.

Not content with the admirable results which the plaster-of-Paris dressing in combination with suspension has given in angular curvature, Dr. Sayre has gone on to apply the same method to idiopathic or rotary lateral curvature. His views on the great value of self-suspension in this affection, followed by, and, indeed, accompanying fixation with support, were expressed at length before the New York Academy of Medicine in March last. There is one point to which he referred at that time in the way of caution as regards the employment of self-suspension by a child without the presence of an attendant, to which I desire to call attention, as its pertinence depends on the modification which his instrument-maker has made of my apparatus, namely, the substitution of a compound for a simple pulley. For the purpose of applying the plaster dressing, when another person makes traction, and is compelled to continue it for a considerable length of time, this modification is unquestionably very desirable, as diminishing the amount of force which the assistant must exert. But, for self-suspension, it is without this advantage, and entails the risk which Dr. Sayre took pains to indicate, of permanently hanging the patient by the fouling of the rope in the compound tackle. The *spinal swing*, in the shape in which I have it made for patients to use at their own homes, is, as you see, a very simple and not a bulky affair. (Fig. 2.) It consists of a stout iron hook riveted to a plate which can be firmly attached by four screws to a joist in the ceiling, or the frame of a doorway. On

Fig. 2.



Self-Suspension by Means of Dr. Lee's Spinal Swing.

Fig. 3.



Suspension in Connection with Locomotion (Mode of Prof. J. K. Mitchell) by
Means of Darrach's Wheel-crutch with Head-sling.

this hook is hung an iron wheel-pulley provided for that purpose with a strong eye. Over the pulley passes a rope, to one end of which is attached a steel bow having its concavity downwards, and bearing hooks at each end, which support the head-sling. This latter is simply two strong leather straps lined with chamois, one of which broadens in the middle, and has an oval cut in it at that point for the reception of the chin; while the other, attached to the first, at an oblique angle, at a point just above the top of the ear, passes around under the occipital protuberance, and is buckled at a corresponding point on the opposite side. The other end of the rope runs through two wooden ovals, which are fixed at the proper height by tying a knot under each. These form handles by means of which the patient makes traction. They should be about four inches apart, the lower one being a little above the level of the top of the patient's head. If, as is often very desirable, it is wished to keep up the extension longer than the patient's strength will permit him to continue the traction with the hands, this may be readily accomplished by attaching a weight, as, for instance, a sand bag, to the free end of the rope. The child can then sit, stand, lie, walk, change its position at will, even romp with a playfellow, and still the weight of the head and upper part of the trunk will be in great measure removed from the diseased vertebra. I have had little patients who would spend literally the greater part of the day in this state of semi-suspension, happy, contented, and free from pain. When it is desired to make use of suspension in connection with locomotion, the wheel-crutch (Fig. 3), already referred to, answers the purpose admirably, but the precaution should then be taken, as also when the suspensory bow is hung from the top of a child's carriage, to make the medium of suspension a rubber or spiral-wire spring, in order to avoid the transmission of jolts and shocks in the spine.

Vertical Suspension by the hands alone is a valuable means of producing spinal extension in all cases of lateral curvature, and in those cases of angular curvature in which the seat of inflammation is below the level of the shoulders. The apparatus with which it is performed are the *ladder* and the *trapeze*. The *ladder* (Fig. 4) may be either an ordinary house-carpenter's ladder, or, what is rather better suited to the purpose, a single vertical upright, six inches broad, with stout pegs, six inches long, projecting from either side, opposite, and six inches apart. The central shaft keeps the hands and feet at the proper distance apart. To use it

in lateral curvature, the patient should stand facing it, and reach up with the hand corresponding to the depressed shoulder to the highest peg which he can grasp standing on tiptoe. He should then take hold of the next lower peg on the opposite side with the other hand, and pull himself up by both arms until he can rest both feet on the first pegs. He should now rest a full minute, and then repeat the manœuvre on the next higher pegs on both sides, and so on until he has ascended six or eight pegs. He should now let himself down cautiously and slowly from peg to peg, resting as before, until he reaches the floor again, when he will have taken sufficient exercise for this particular set of muscles for that hour. By this means, he will have given the inter-articular cartilages an opportunity to expand to their natural thickness, and will have put the contracted muscles on the concavity of the curve more strongly on the stretch than their opponents. In angular curvature the procedure is the same, except that it is rarely necessary to take hold of pegs of different heights.

The *trapeze* (Fig. 5) is a stout round bar of hickory or ash, three feet long, and four inches in circumference, supported horizontally at each end by a rope fastened to a frame, or to a staple in the ceiling, and having a length of from four to six feet. As a matter of convenience it is well to have the ropes so attached that the bar can be raised and lowered. In angular curvature this is used simply as a hand swing, and is not only of value in extending the spine, but affords a pleasant pastime and a healthful exercise. It does not, however, of course, exert as efficient an extending force directly upon the spinal column in the line of its axis as the spinal swing, and cannot be substituted for it, although it constitutes an admirable adjuvant.

In lateral curvature it is susceptible of an excellent adaptation in the following way: The bar being suspended four inches above the head of the patient, she should grasp it firmly with both hands, held about two feet apart. The feet should be close together, and it is as well to confine the toes in straps fastened to the floor. The knees are to be held stiff. An assistant, standing behind the patient, then places one hand under the axilla corresponding to the depressed shoulder, in order to give the patient a sense of security, and with the other makes firm pressure against the convexity of the opposite side, until the patient's arms are stretched out perfectly straight. In this position the principal

Fig. 4.



Vertical Suspension by the Hands, by Means of the Ladder.

Fig. 5.



Lee del.

Vertical Suspension by the Hands, by Means of the Trapeze, as used in Lateral Curvature.

curve is, to a great extent, redressed, the body being bent forcibly in the opposite lateral direction. The pressure is continued as long as the patient can retain her grasp with entire ease, usually about fifteen seconds, and then relaxed. After a rest of one minute the operation is repeated. From nine to twelve repetitions are sufficient at one time. Another mode of using the trapeze with advantage in lateral curvature is what is known as *rotation*. This is peculiarly beneficial in overcoming rigidity of the spinal muscles and ligaments, with the additional merit of throwing all the muscles of the trunk into lively action, and developing the capacity of the thorax. The attitude of the patient is the same as before, but the bar should be somewhat higher. The assistant seizes the clothing of the patient firmly at a point opposite the middle of the sacrum, and compels her pelvis to describe a circle with a considerable degree of rapidity. The muscles of the front and back of the body, as well as of the sides, are by this means alternately stretched and relaxed, and their capillary circulation thus greatly accelerated, while every joint of the spine is compelled to take part in the movement.

Oblique suspension by the hands is employed only in lateral curvature, and requires a special apparatus, of which the following is the description (Fig. 6). On a heavy wooden platform, of the dimensions of three feet by a foot and a half, is erected, at its middle point, a firm casing of inch stuff, twenty-eight inches high, inside which plays, vertically, a wooden upright five feet eight inches high, four inches broad, and an inch and a quarter in thickness, susceptible of adjustment at any height by means of a ratchet. This upright is hinged twenty-eight inches from its lower end, in such a manner that it can bend away from the patient, but not towards her. It carries, just above the hinge, a curved pad, and higher up a horizontal hand-piece for both hands, projecting about fourteen inches, and movable up and down the shaft. A treadle is hinged to the platform, on the same side as the hinge of the upright, and to the extremity of this treadle is fastened a light rope, which, after passing through the end of a gaff, is attached to the top of the upright. Depression of the treadle, therefore, at once causes the upright to bend through its hinge. The apparatus must be so adjusted that when the patient stretches up, to her fullest extent, to grasp the hand-piece with both hands, the pad shall press a little below the middle of the convexity of the projecting shoulder. The

assistant, then, depressing the treadle with her foot, the patient is slowly lifted off her feet until she is entirely suspended by the hands; all that part of the trunk which is above the level of the hinge being compelled to conform to the oblique position of the upper portion of the upright, while the portion below hangs vertically. Thus, not only does the weight of the pelvis and lower extremities act as an extending force in the line of the spinal axis, but it also directly unbends the curve. At the same time the arm corresponding with the low shoulder is forced to describe a longer curve than the other, and the contracted side is thus put forcibly on the stretch. This is a very powerful means of treatment, and the suspension cannot, of course, be borne for more than a few seconds. It may be repeated about a dozen times.

Horizontal suspension, on the other hand, is a mild form of application of force, and may be continued for an hour or two unintermittingly. It has been in use from time immemorial, and was probably the earliest method which suggested itself to the mind of man for remedying a lateral distortion of the spine. The apparatus best known for its employment is called "Lonsdale's couch." It is thus described by its inventor: "It is six feet in length and two feet in width; the horizontal portion on which the patient lies consists of a framework divided into three parts; the central portion, which is the smallest, is fixed and connected to the sides of the couch, more towards the upper than lower end, to be opposite to the thorax when the patient is placed upon it. To this central portion there are two others attached by hinges moving up and down like the flaps of a table, and which admit of being fixed at any angle by means of sliding quadrants that pass through two bars extending from the under part of the central portion of the couch down to two spindles that connect the legs together. The ends of the couch itself are disconnected at the upper and lower part, so as not to interfere with the motion of the flaps. By this means the level of the legs, or of the head and shoulders, can be altered at pleasure, by letting either the upper or lower flaps of the framework, or both, fall as much as may be required. . . . When the patient is placed upon the couch, the body is supported by a sling made of a broad belt six or eight inches wide, attached by a strong strap and buckle on either side to a perpendicular framework or yoke thrown across the couch and fitting into it, nearer to the

Fig. 6.



Oblique Suspension by the Hands in Lateral Curvature.

Fig. 7.



Horizontal Suspension, in Lateral Curvature, by Means of Lonsdale's Sling and Taylor's Swinging Couch.

upper than the lower end. The belt should be so placed that the pressure may tell on the most convex portion of the thorax, the body being slightly turned on the back, so as to support the angle of the ribs more than the centre, and to support the scapula as well." Lonsdale, though evidently, judging by this extract, not a master of the English language, was an ingenious mechanician, and his couch answers an admirable purpose. It is too complicated, however, for any situation but the orthopaedic gymnasium. The form in which I use it in my own (Fig. 7) is a combination of the sling with the swinging couch, described by Dr. C. Fayette Taylor, of New York, in a paper before the Medical Society of the State of New York, entitled the "Causes of Backache in American Women." This consists of a firm rectangular frame three feet high, one and a half feet broad, and three feet long, upholstered on top, to one end of which is hinged an upholstered leaf of the same dimensions as the top of the first, and forming with it, therefore, a continuous couch six feet long. To one side of this leaf is attached a horizontal lever carrying a movable weight. This weight acts as a counterpoise to the limbs of the patient, which rest upon it, while the body rests upon the fixed portion of the couch. The frame which bears the sling is supported in sockets on either side of the fixed frame, at the appropriate point. In use the weight is so adjusted that the limbs shall incline downwards, thus making a slight extension of the contracted muscles; while, at the same time, the lower leaf being movable and in a state of equilibrium, gentle exercise of the muscles of the weaker side becomes practicable, in combination with the un-bending action of the sling.

The sling, however, can be used with very beneficial results without the couch. Even upon an entirely horizontal surface the convexity of the projecting shoulder may be efficiently supported, so that the weights of the head and shoulders above, and of the lower portion of the trunk below, are utilized in unbending the curve by direct action. This sling is constructed by my instrument-maker, Mr. E. Spellerberg, 105 S. 10th St., Philadelphia, in a convenient form for home use. It can be used advantageously upon any firm couch, requiring no fixed attachment. Its employment for an hour or two daily in the earliest stage of a lateral curvature would, in many cases, avert serious and irremediable deformity.

RECAPITULATION.

Extension of the spinal column, for the purpose of relieving diseased vertebrae from pressure, or of overcoming deformity, can be effected only by apparatus having a fixed point of support unconnected with the body of the patient, by means of which he is suspended, the weight of the body and limbs forming the extending force.

SPINAL SUSPENSION may be DIRECT—*by the head alone*; the counter-extending force being exerted by means of a ratchet and key. The apparatus for this purpose is designated the *spinal extensor*. It may be attached to a chair, for use in sitting, or to any vertical woodwork of an apartment, for use in standing.

MODIFIED—*by the head and hands*, also called SELF-SUSPENSION; the counter-extending force being exerted by the manual traction of the patient himself on one end of a cord, the other end of which, after passing over a pulley, is attached to the head sling. The apparatus for this purpose is designated the *spinal swing*. It may be attached to a wooden frame or to a joist in the ceiling. Modified suspension is also effected by attaching a head sling to the wheel crutch, in which case the weight is partially transferred by the hands to the crutch; and by substituting for the traction by the patient in the spinal swing that of a weight, about equal to that of the patient's head, attached to the manual end of the rope. Spinal suspension by these methods is useful both in angular and lateral curvature of the spine, first as a direct means of treatment; secondly as a means of placing the spine and trunk in the best possible position for the application of instrumental support, whether fixed or movable, and also for the performance of tenotomy.

VERTICAL—*by the hands alone*; the counter-extending force being exerted by the manual traction of the patient upon a bar overhead. The apparatus for this purpose, if fixed, is designated the *ladder*, and, if movable within limits, the *trapeze*. Both are useful in lateral curvature in all stages, but in angular curvature only when the disease is situated below the fourth dorsal vertebra. The latter requires the aid of an assistant to use it to the greatest advantage.

OBLIQUE—*by the hands alone*; the counter-extending force being exerted, by an assistant, through the medium of a hinged lever, by traction upon the hands of the patient. The apparatus for

this purpose is appropriate only to an orthopædic gymnasium. It is designed for lateral curvatures, and is a powerful and efficient means of treatment.

HORIZONTAL—*by the trunk*; the counter-extending or unbending force being exerted by a leather strap, which supports the side of the thorax of the patient in the horizontal posture. The apparatus for this purpose is designated the *spinal sling*, or *Lonsdale's sling*. Although most effective in connection with an inclined or swinging couch, it may be used in connection with an ordinary couch or bed, if sufficiently firm. It is especially applicable to lateral, but may also be cautiously employed in angular curvatures. Being gentle in its action, it may be advantageously used for considerable periods, and is entirely appropriate to the home.

Corollaries. I. If, as is maintained in the foregoing essay, muscular contraction invariably accompanies and aggravates spinal distortions of every kind, it follows that simple rest in the prone or supine posture is not in itself a mechanical agent of sufficient power to overcome or relieve them.

II. If, as is maintained in the foregoing essay, the condition in vertebral caries is closely analogous to that existing in an ununited fracture of a long bone, it follows that the patient can never be so reduced or exhausted as to render the use of mechanical means dangerous or inappropriate.

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